Comment on:

* EMCal granularity
* EMCal calibration

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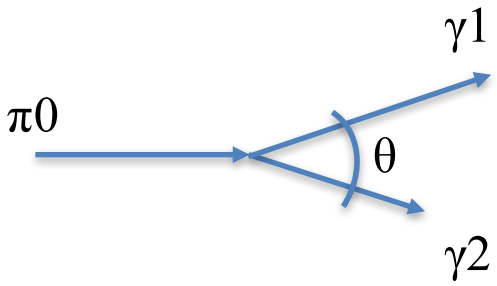
On EMCal Granularity

Granularity and π0/γ discrimination in EMCal (alone)

"Usual" criteria:

π → γγ distinguished if photons are separated by 1 tower size



$$\theta = \frac{2m_{\pi 0}}{E_{\pi 0}\sqrt{1-\alpha^2}} \qquad \alpha = \frac{E_{\gamma 1} - E_{\gamma 2}}{E_{\gamma 1} + E_{\gamma 2}}$$

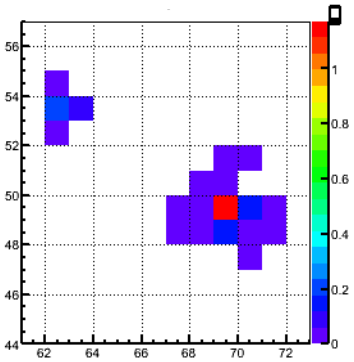
$$\theta_{min} = \frac{2m_{\pi 0}}{E_{\pi 0}}$$

Θ_{min}	$E_{\pi 0}$ GeV
0.005	54
0.01	27
0.02	13.5

π0/γ reconstruction

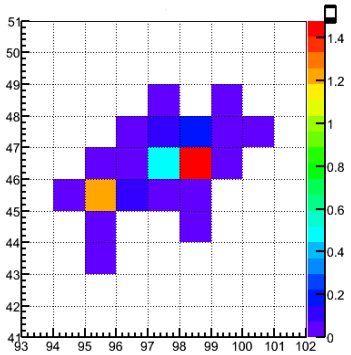
Barrel EMCal with granularity ~0.025

2 GeV π0



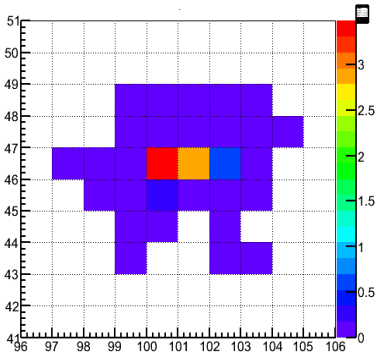
Two fully separated clusters

4 GeV π0



Two sub-clusters

8 GeV π0



One (sub-)cluster

Requires special technique based on energy distribution among towers, e.g.

Fit to pi0 hypothesis

Single photon or not?

Cluster width, χ^2, etc.

Granularity and π0/γ discrimination in EMCal (alone)

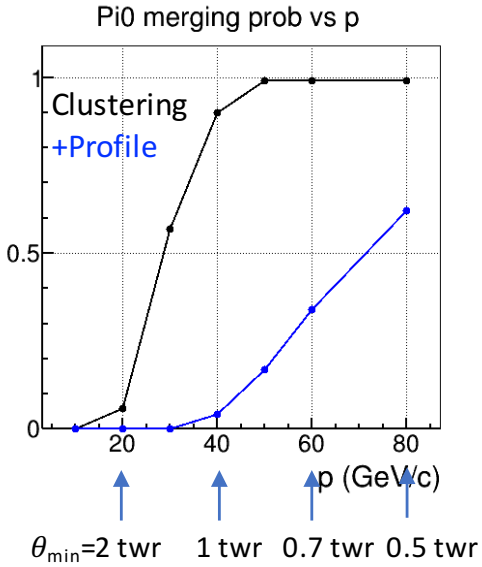
$$\theta_{min}^{\pi 0 \to \gamma\gamma} \approx \frac{2m_{\pi 0}}{E_{\pi 0}}$$

$\pi 0 \to \gamma\gamma$:

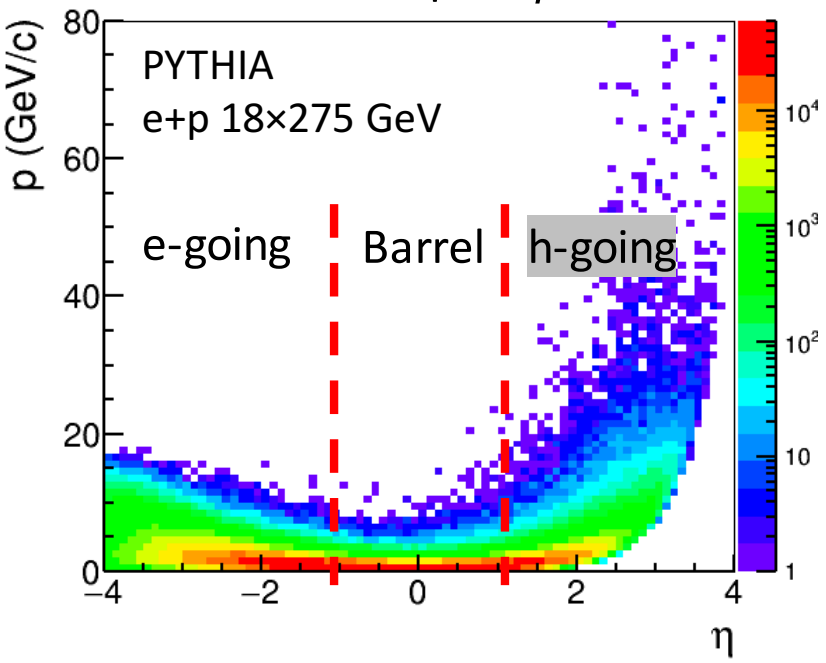
"Simple" clustering distinguishes two photons if they are separated by 1.5–2 tower distance in EMCal

Shower profile analysis distinguishes merged photons from single one if they are separated by 0.5–1 towers.

GEANT4:
Forward EMCal with granularity ~0.007 (2×2 cm^2 at z=3m)



Pion: p vs η

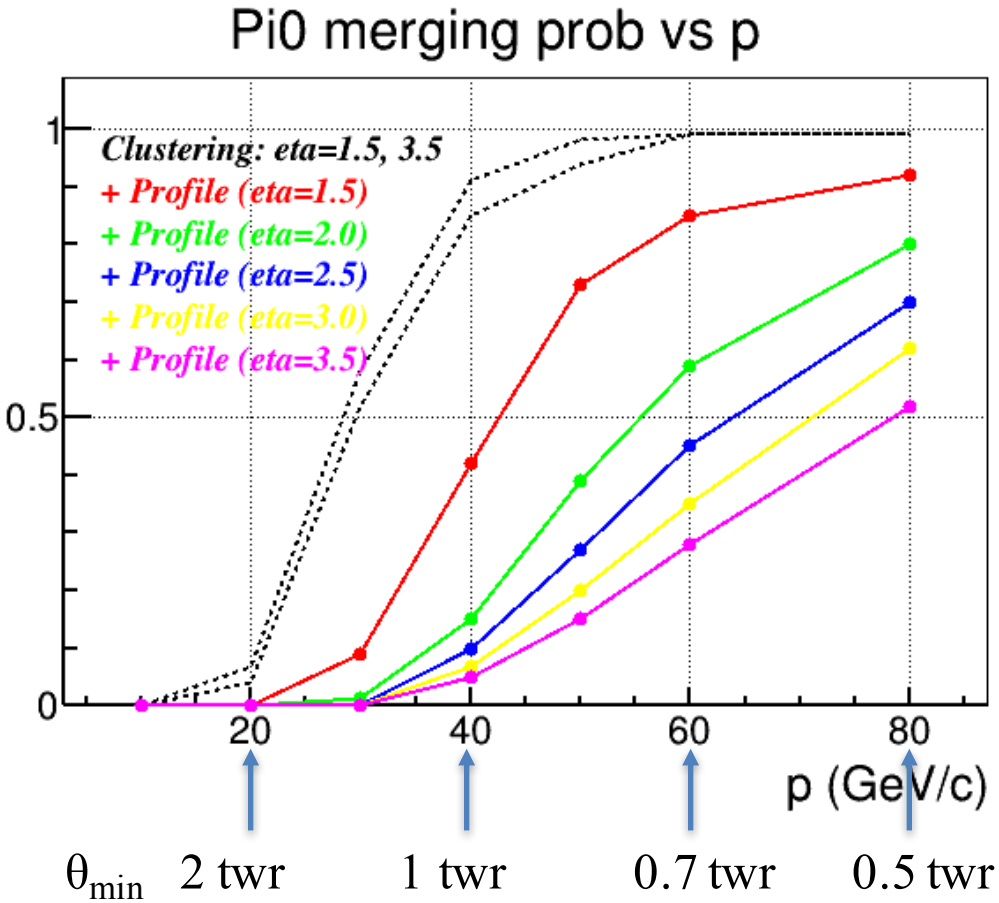


Pion momenta are limited by ~10 (~15) GeV/c in barrel (e-going) => Granularity of 0.03 (0.02) looks sufficient

<0.01 granularity may be needed for h-going

vs pseudorapidity

$$\theta_{min} = \frac{2m_{\pi 0}}{E_{\pi 0}}$$



GEANT4:
Forward **non-projective** EMCal with granularity ~0.007 ($d \times d = 2 \times 2 cm^2$ at Z=3m)

Scalable with Z and d:

$Z \rightarrow Z \cdot k \quad p \rightarrow p \cdot k$

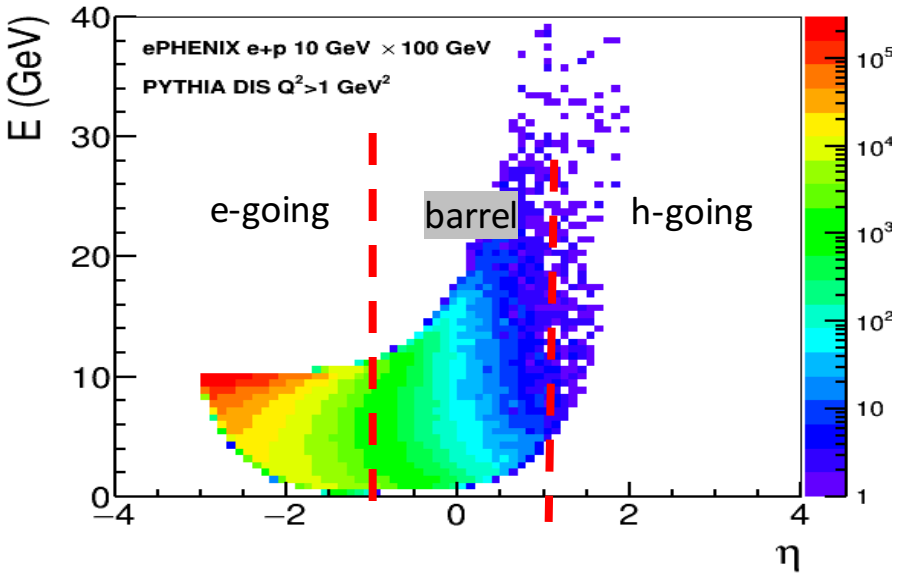
$d \rightarrow d \cdot k \quad p \rightarrow p/k$

For projective geometry:
All colored lines expected to be at or below the magenta one

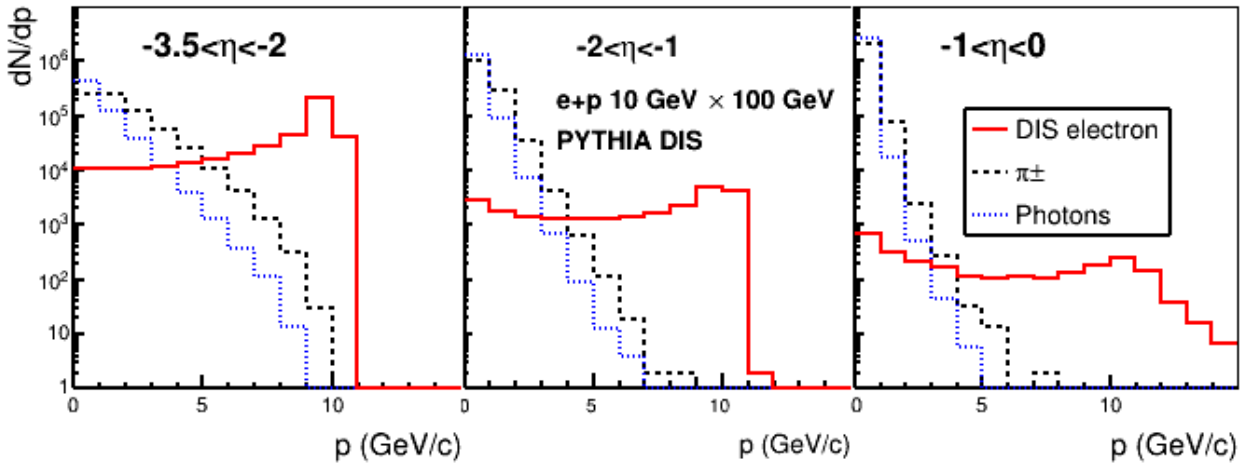
On EMCal Calibration

Calibration with Electron

e+p 10x100 GeV



No good statistics expected at h-endcup



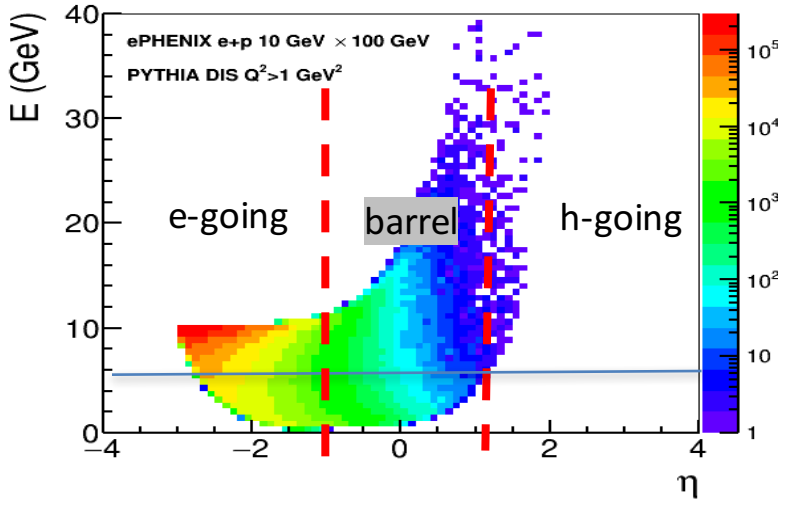
Conservative approach:

At least ×100 suppression expected for h±

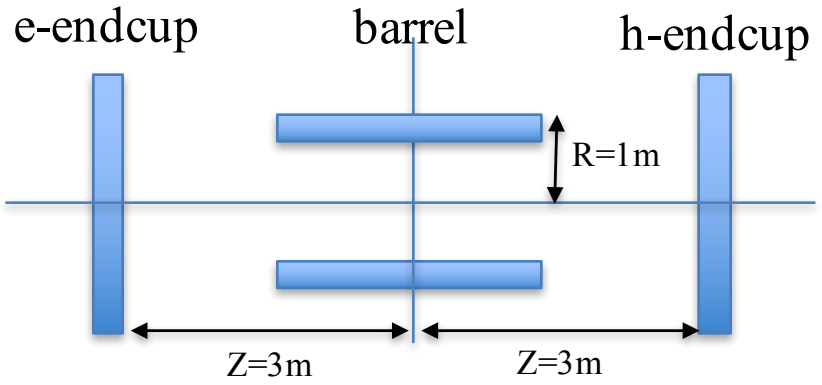
=> Will get a clean electron sample at >5 GeV/c

Calibration with Electron

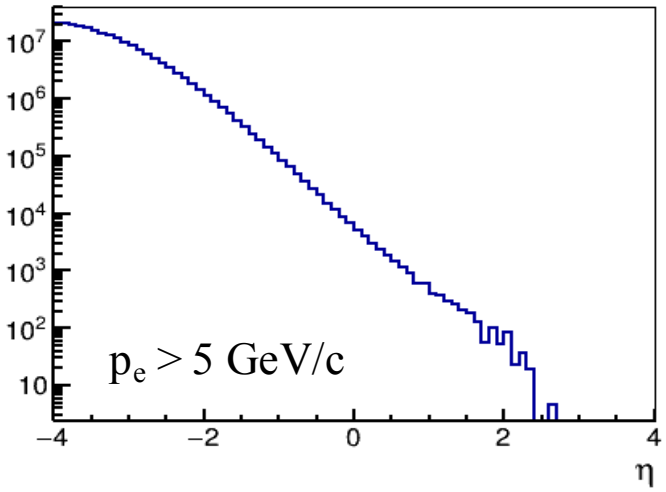
e+p 10x100 GeV



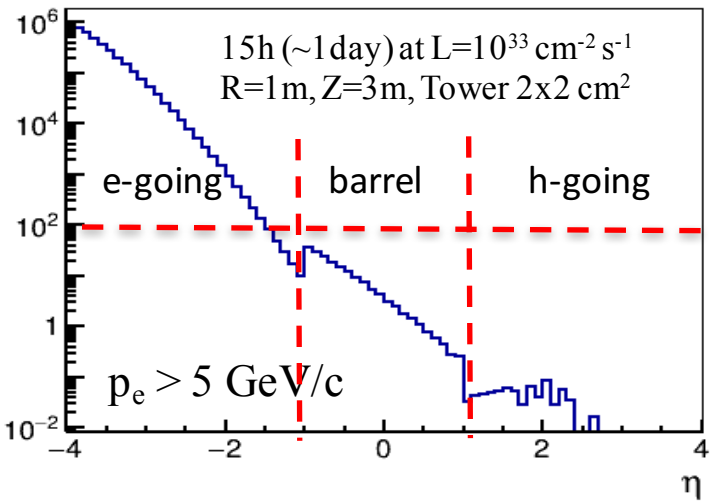
Tower size d×d=2×2 cm²



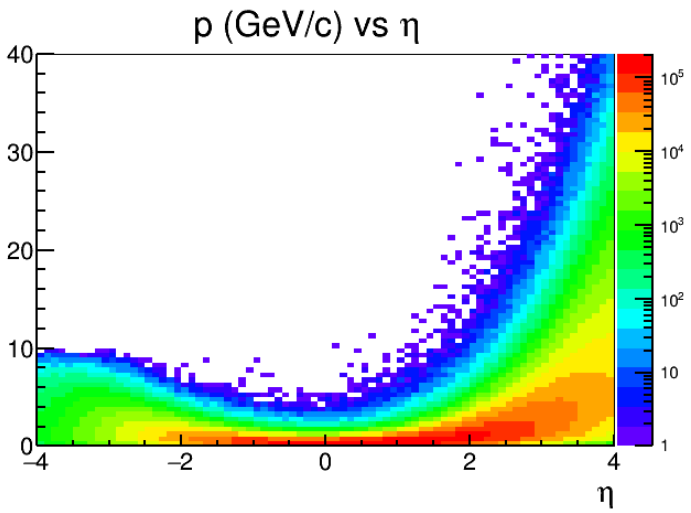
dN/dη vs η

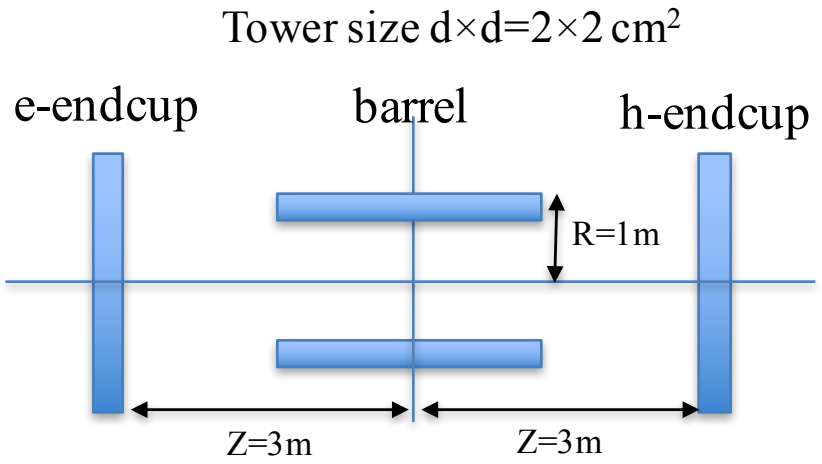


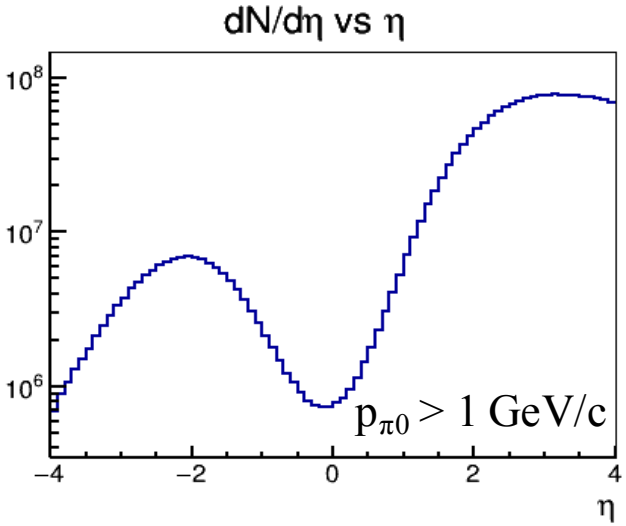
N/Tower vs η

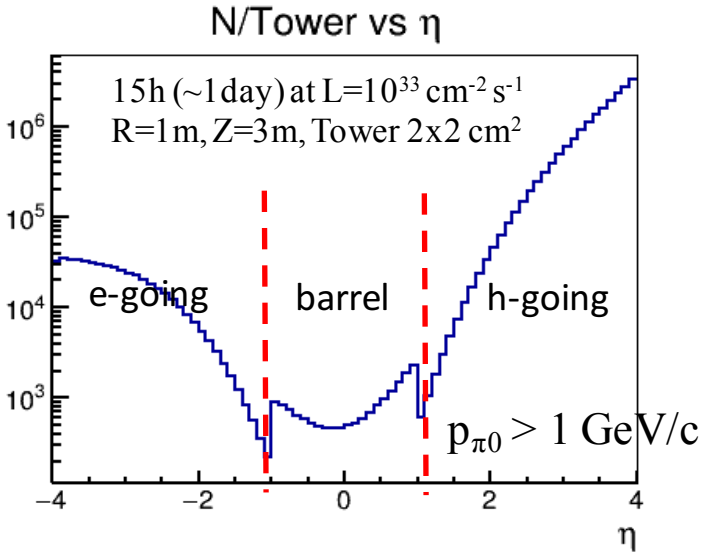


Calibration with π0









EMC Calibration: Summary

Scalable with R, Z, d:

$Z \rightarrow Z \cdot k \quad N \rightarrow N/k^2$

$R \rightarrow R \cdot k \quad N \rightarrow N/k^2$

$d \rightarrow d \cdot k \quad N \rightarrow N \cdot k^2$

"Usually" a few hundred particles per tower needed

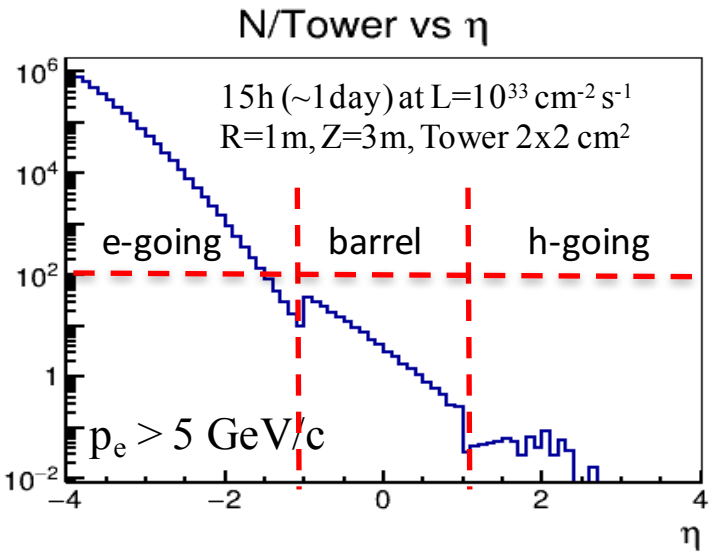
Depends on resolution, gain alignment, background, other syst. effects

Endcup: Z=3m

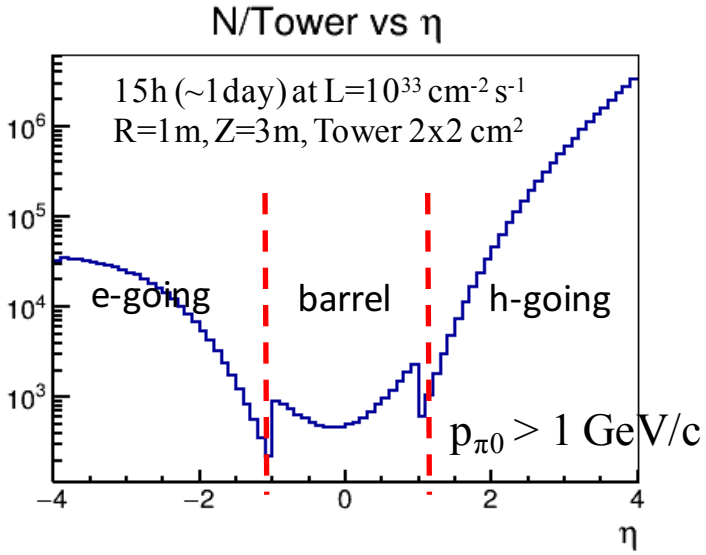
Barrel: R=1m

d×d= $2\times2\ cm^2$

Electron



$\pi0 \rightarrow \gamma\gamma$



- ✓ 1-day statistics is enough for e-endcup
- ✓ Barrel needs more data
- ✓ Not enough for h-endcup

1-day statistics looks enough for all EMCals